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Research Article

Study the Effects of Two Multivitamin Syrups on the Properties of the Composite Surface

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ABSTRACT: The current study aimed to determine the impact of multivitamin syrups applied daily on the surface microhardness and roughness of composite restorative materials. **Materials and Methods:** Forty disc-shaped composite specimens (2 mm thickness, 8 mm diameter). The samples were immersed in two multivitamins for 2 minutes, once a day, for 20 days. Surface microhardness and roughness measurements were taken at the baseline and after 20 days. A Vickers hardness tester and a surface profilometer were used to measure the surface microhardness and roughness. **Results**: Statistical examination of findings using the ANOVA test revealed that surface microhardness was decreased, and surface roughness was increased. These results from baseline to 20 days in each syrup, with Omega 3 showing the greatest decrease in microhardness, followed by BONVIT. **Conclusion:** After continuous usage of a drug or syrup, the material becomes more exposed to an acidic environment, making it more likely that this will affect the microhardness and roughness of the cosmetic restorative material.

Keywords: Composite; Microhardness; Multivitamin; Omega3; Roughness.

INTRODUCTION

Pediatricians and doctors give medications for a variety of conditions using oral, nasal, cutaneous, sublingual, parenteral, rectal, and other modes of administration. orally is the most widely utilized and traditional method of administration.

Syrups are commonly advised for children because swallowing oral medication in the form of capsules or pills is impractical for them [1]. As the number of children with systemic illnesses grows, so does the usage of pediatric liquid medications. The active molecules in these medications are necessary for developing or sustaining health, but some of the inactive ingredients may be harmful to teeth. The solubility of some chemicals in syrups is pH-dependent; hence, these medications are acidic formulations designed to maintain chemical stability, maximize the efficacy of the substance, and ensure optimal drug dispersion. The acidity also helps to improve the taste of the solution [2].

Drugs with low pH and frequent contact with teeth can induce dental erosion, which damages teeth and lowers the longevity and clinical performance of dental restorations. Thus, there is a need to examine the influence of such drugs on dental restorative material [3]. Tooth-colored restorative materials are available in various forms, each with a unique collection of colors and physical characteristics.

In pediatric dentistry, composites and resin-modified glass ionomers have been utilized to restore decayed areas and, more crucially, to correct misaligned teeth and enhance smiles. Resin-based composites are gaining popularity in dentistry, notably due to their superior cosmetic results. They are typically made of a methacrylate-based resin matrix, glass or ceramic fillers, and a filler-matrix coupling agent. The primary advantages of composites are their cosmetic features and excellent binding strength to tooth structure. However, its success in use is dependent on the application technique [4].

Because of the conditions in the oral environment, the mechanisms that cause deterioration of restorative materials are complicated. When choosing materials to heal erosive lesions, acid resistance is an important factor to consider. The capacity to endure pressures and chemical assaults encountered in the oral environment is one of the most desirable features of a restorative material. If these hurdles are mastered, the restoration will be available for an extended length of time [5]. The rising frequency of tooth erosion necessitates a better understanding of degradation processes in restorative materials [6]. The purpose of this study was to assess and compare the effects of two pediatric medications on the surface microhardness of aesthetic restorative materials.

MATERIALS AND METHODS

In this experimental comparative study, conducted at the Department of Pediatric and Preventive Dentistry at Tikrit University, two different types of multivitamins were utilized. These were junior Omega 3 (VitaGate), PH (4.2), food supplements rich in omega-3 and essential vitamins. Bonvit (VitaGate), a food supplement rich in calcium, magnesium, zinc, and vitamin D3. Calcium is needed for the maintenance of normal bones. Vitamin D contributes to normal absorption of calcium. PH (4.6), the composite type used was Composite (Filtek Z350) (3M ESPE USA). The acidity is measured with a pH meter. The quantity of H-ions in aqueous solutions is measured. 4.0, 6.86, and 9.18 buffering solutions were used to calibrate this device. The pH meter's protective cap was removed to take the measurement. and switch it on, plunge the pH electrode into the solution, mix gently, and wait for about 30 seconds until the reading stabilizes after first rinsing the electrode with distilled water and drying it with filter paper. To prevent mixing material, the electrode was cleaned with distilled water and rubbed with cotton pads in between measurements [7]

Getting specimens ready, using an acrylic mold, 20 disc-shaped specimens (8 mm × 2 mm) made of composite restorative material were created. Using a plastic tool, the material was placed into the mold and compressed between two glass slides and translucent celluloid strips. During the setting process, the glass slides were securely held in order to prevent air bubbles and produce a flat surface [8].

Using an LED light curing device (Eighteenth, Changzhou Sifary Medical Technology Co., Ltd., China), the material was photopolymerized. At a straight angle, the light probe's tip was pressed up against the glass slide. On both sides, the light activation lasted for 20 seconds. Samples were sorted into two categories. Following their removal from the mold, the specimens were polished using silicon carbide paper disks (Sof-Lex Pop On; 3M ESPE, St. Paul, MN, USA).

The samples were randomly split into baseline group, OMEGA3, and BONVIT for each test (10 samples for each group). They were then put into well-bottomed cell culture plates and submerged in distilled water. For the primary water absorption and complete polymerization process, the samples were stored in distilled water for 48 hours. The initial values of surface roughness (10 samples) and microhardness (10 samples) were measured, documented, and served as the control group. The purpose of the immersion cycling procedure utilized in this study was to mimic real multivitamin use [9].

For 20 days, the specimens (experimental groups) were immersed in 5 ml of medicine for 2 minutes per day, with 24-hour pauses between each cycle. Following

each immersion cycle, the specimens were cleansed and placed in distilled water until the next. The syrups and water were refilled before to each immersion.
After 20 days, all samples' surface roughness and microhardness were assessed. The surface roughness was measured using a mechanical 2D profilometer surface roughness tester that was calibrated (Leeb 432A, Testcoat, USA). Using a cut-off length of 0.25 mm and a diamond stylus with a diameter of 5 μm and a stylus angle of 90, the profilometer measured each specimen's (Ra) under the ISO-DIN 4768 specification for surface roughness measurement. Using a ruler, three measurements were made at crossing directions in the middle of each sample to get the average reading. The microhardness was assessed using a digital Vickers microhardness tester, operated in the Metal Testing Laboratory within the Department of Production Engineering and Metallurgy at the University of Technology. The measurements were taken under a load of 100 grams for a duration of 15 seconds.

RESULTS

The comparison in microhardness between the control group and the group immersed with OMEGA syrup, Student's Independent t-test found that there was a significant difference in the microhardness between the two groups ($P \leq 0.01$), as shown in Table 1. Statistically, the microhardness results between the control group and the group immersed in BONVIT syrup showed a significant difference, $P \leq 0.01$, as shown in Table 2.

Table (1): Micro hardness changes between the control group and the group with Omega-3

	N	Mean	SD	SE Mean
OMEGA	10	30.23	1.93	0.61
Baseline	10	40.650	0.818	0.26
	T-Test of differe 0 (vs≠):	T-Value= 15.73	P-Value= 0.01	

Table (2): Micro hardness test between the control group and the group with Bonvit

SYRUP	N	Mean	SD	MEAN SE
BONVIT	10	35.03	1.920	0.61
Baseline	10	40.65	0.818	0.26
	T-Test of diffe = 0 (vs≠):	T-VALUE=8.51	P-Value =0.0	

Table 3 illustrates the differences between the three groups of samples. ANOVA Test found that there was a significant difference between the control, Omega group, and Bonvit group, with P ≤0.01, and the group immersed in OMEGA showed the most affected group with the least micro hardness.

Figure

(1) illustrates a comparison between Baseline, Omega3, and Bonvit microhardness, which shows a reduction of microhardness from 40 for the baseline to 30 for the group immersed in Omega.

The results indicated a significant increase in surface roughness for the OMEGA syrup group compared to the control group ($P \leq 0.005$), as shown in Table 4. The BONVIT syrup group also displayed a significant increase in surface roughness compared to the control group ($P \leq 0.008$), as illustrated in Table.5

Table 6 shows the differences in surface roughness among the control, Omega, and Bonvit groups, which found a significant difference (P ≤0.002). The group immersed in OMEGA syrup exhibited the highest roughness, while the Bonvit group also showed an increase in roughness compared to the control.

Table (3): Micro hardness test between the control group and the group with BONVIT and the OMEGA3 group

Factor	N	Mean	SD	
Baseline a	10	40.650	0.818	Pooled SD = 1.64122
OMEGA3	10	30.230 c	1.928	F-value =100.98
BONVIT	10	35.030	1.922 b	P-value =0.01

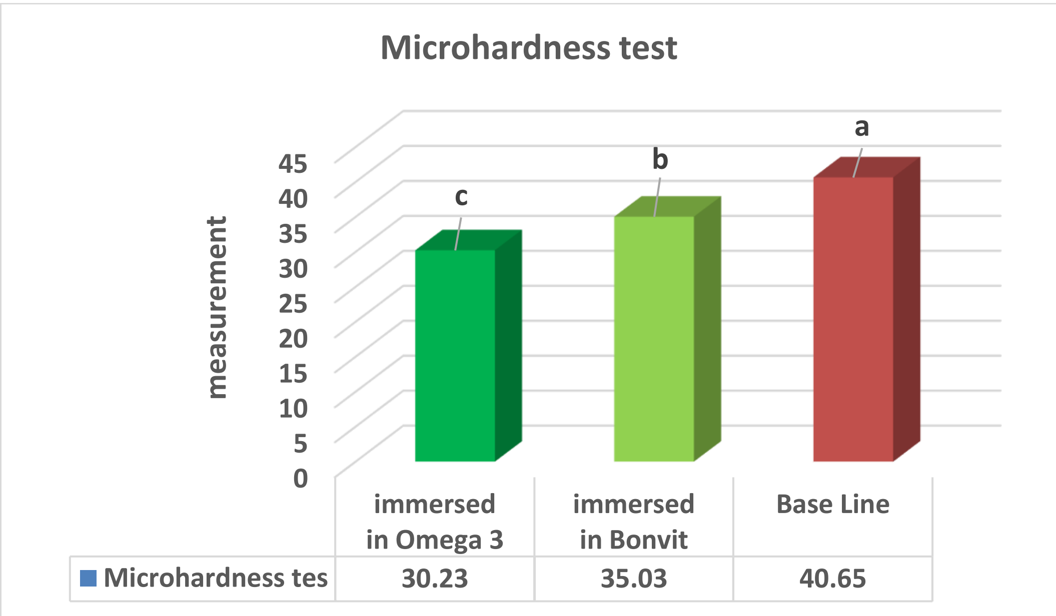

Figure (1): Comparisons of microhardness of composite at baseline, after immersion with Bonvit., and after immersion with Omega 3.

Table (4): Surface Roughness Changes Between Control Group and Omega-3 Group

Group	N	Mean	SD	SE
OMEGA	10	1.30	0.15	0.05
Baseline	10	0.90	0.10	0.03
T-Test of difference = 0 (vs ≠): T-Value = 8.00 P-Value = 0.005				

Table (5): Surface Roughness Test Between Control Group and Bonvit Syrup Group

Group	N	Mean	SD	SE
BONVIT	10	1.20	0.12	0.04
Baseline	10	0.90	0.10	0.03
T-Test of difference = 0 (vs ≠): T-Value = 7.00 P-Value = 0.008				

Table (6): Surface Roughness Test Between Control Group, Bonvit, and Omega-3 Group

Factor	N	Mean	SD
Baseline	10	0.90	0.10
OMEGA3	10	1.30	0.15
BONVIT	10	1.20	0.12
Pooled SD = 0.133			
F-value = 45.00			
P-value = 0.002			

DISCUSSION

Microhardness and roughness are critical parameters that influence the performance and longevity of composite materials. Microhardness assesses a material's resistance to localized deformation, providing insights into its durability and wear resistance [4]. On the other hand, surface roughness affects adhesion, friction, and overall aesthetic quality. Understanding the interplay between these properties helps in optimizing composite formulations for various applications, from aerospace to biomedical fields [6]. This analysis is essential for developing composites that meet specific performance criteria while ensuring reliability and efficiency [2, 9].

One of the most prevalent chronic illnesses worldwide is caries. This is the result of a protracted, intricate relationship between fermentable carbohydrates and acid-producing bacteria [10], in which host elements like saliva, teeth, and nutrition all play significant roles. Other than dental caries, there are several other reasons why a tooth may need to be restored or repaired [11].

Low pH liquid drugs have the potential to cause surface erosion and negatively impact dental restorations. Dental disease is more common in children with chronic illnesses and those who use drugs for extended periods of time [12]. Therefore, we tested the impact of liquid syrups on aesthetic repairs in our inquiry. The producers of the multivitamins selected for this study did not supply the pH information. Consequently, a digital pH meter was used to determine the pH of each solution prior to the study. The multivitamins Bonvit and Omega3 junior had pH values of 4.6 and 4.2, respectively, that were noted.

The micro hardness and surface roughness tests were chosen for this investigation since the endurance of the material and its characteristics, such as hardness and wear resistance, determine how long a dental restoration will last. The ability to withstand long-term penetration or indentation is known as hardness. It is used to gauge a material's resistance to wear and its capacity to erode the opposing tooth structure [13] Because distilled water mimics a moist mouth cavity and has a pH that isn't acidic, it was chosen for this investigation's control and storage medium. Surface roughness in glass ionomer cement refers to the texture and irregularities present on the surface of the material after it has set and cured.

For the materials utilized in this investigation, Shade A2 was selected for uniformity and to lessen the impact of color variations. The most popular restorative material is composite (3M), which Tamer Tüzüner14 has cited in a number of investigations.

The present investigation involved immersing specimens for two minutes each day to elicit a brief interaction between restorations and medications. In order to replicate the clinical setting, the specimens were preserved in distilled water after each immersion cycle. The results of the study indicate that composite microhardness declines after exposure to the two multivitamins. This decline may be attributed to the acidic pH, which causes matrix softening, surface abrasion, and the destruction of structural ions. The acidic pH of the multivitamins can lead to matrix softening of the composite material. When the matrix becomes softened, it loses some of its structural integrity, making it more susceptible to abrasion and wear [14]. This softening can result in the formation of irregularities and protrusions on the surface, thereby increasing roughness [15].

The study's findings showed that soaking a composite surface in a particular soft drink significantly decreased the surface's microhardness. According to Criag R and O'Brien WJ [16], the Vickers micro hardness test was used for this study because it is a reasonably easy, widely used, and reliable method of obtaining data. All of the materials submerged in distilled water showed a decrease in surface microhardness and an increase in roughness.

DI Hamadamin et al. [17] state that the reason for the decrease in surface hardness of the restorative materials after storage in distilled water is that water acts as a plasticizing molecule within the resin matrix, softening the polymer resin by enlarging the network and reducing the frictional forces between polymeric chains. Softened materials are more likely to experience wear during handling or exposure to mechanical forces, which can result in a rougher surface profile. As the polymer chains are loosened, the material may lose small particles from its surface, creating irregularities that lead to increased roughness. However, Badra et al. [18] found that immersion in distilled water increased the hardness of the resin-composite restorative, contradicting the previous finding. This may be due to elution of unreacted components from the resin-composites, post-irradiation, and post-setting polymerization.

The results of this study indicate that the surface hardness of restorations coated with medications may be lowered while the surface roughness is increased. This phenomenon may be attributed to a combination of factors, including the amount of acid in the medication, its PH, the medication's adhesion to tooth enamel, buffering capacity, mineral content, and an individual's salivary flow rate. Dental degradation may be predicted by PH, according to research by Hara and Zero et al. [19]. Gurdogan

Guler EB et al. [20] state that the long-term usage of effervescent tablets and multivitamin syrups alters the properties of restorative materials. Our findings are consistent with those of Zhoa D. et al. [21] and Dhwan L. et al. [22] and indicate that liquid absorption degrades material surfaces regardless of the kind of medication used.

Our result is also in accordance with Valera, B et al. [23], who state that acidity dissolves the matrix more, facilitating the dislodgement of filler particles and leaching out, and reducing the load resistance of restorative materials [24]. They assert that by changing the components of medications, undesirable effects, such as changes in the color, hardness, and roughness of dental surfaces and restorative materials, can be prevented. Pharmaceutical businesses must disclose the type and quantity of sweetener used, along with the potential for tooth decay. In reality, it is recommended that medications without cariogenic substances be introduced to the market, with a "Teeth Friendly" label. Parents know that sugar can lead to tooth decay, but many are not aware of the foods and drinks that include sugar, including long-term liquid medications. The pediatrician is a valuable resource for informing the public about the risks associated with using liquid drugs for extended periods of time.

The availability of children's unsugard liquid medicine will encourage doctors and dentists to recommend it. The direct impact of sugar-containing medications on the surface of the enamel must be further investigated before any steps are taken to stop the erosion of teeth due to PLMs. We did not investigate the effects of temperature swings, pH levels, salivary enzymes, and the ionic content of meals or beverages on the characteristics of restorations in the oral cavity.

Precautions should be taken with both syrup and effervescent versions of multivitamins, such as not leaving the formulation in the mouth for an extended period of time and not brushing right away after usage. Fluoride-containing products, sugar-free chewing gum, or just washing one's mouth with water may be advised as a pH neutralizer. Pediatric dentists should urge parents to take their children to the dentist frequently for both the motorization of current restorations

CONCLUSIONS

Within the limitations of the current study, the continuous usage of a drug or syrup, the material becomes more exposed to an acidic environment, making it more likely that this will affect the microhardness and roughness of the cosmetic restorative material.

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Authors' Contribution

Khaudhair AT contributed to conceptualization, validation, and writing the original draft. Kamil SS was responsible for formal analysis, methodology, project administration, supervision, and review & editing of the manuscript. Alwan SQ contributed to the investigation, software, validation, and visualization. Al-Shammari SM was involved in data curation, resources, and review & editing. All authors have read and approved the final manuscript.

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Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript

Availability of data and materials: All data generated or analyzed during this study are included in this published article and its supplementary information files.

Declaration of Generative AI and AI-assisted technologies

No generative AI or AI-assisted technologies were used in the preparation of this work. The authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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دراسة تأثير شرابين متعددي الفيتامينات على خصائص السطح المركب

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الملخص

الأهداف: تهدف الدراسة الحالية إلى تحديد تأثير شرابات الفيتامينات المتعددة المُستخدمة يوميًا على صلابة وخشونة سطح مواد الترميم المركبة. **المواد وطرائق العمل:** في هذه التجربة، تم استخدام 40 عينة مركبة على شكل قرص (سمك 2 مم، قطر 8 مم). غُمرت العينات في نوعين من الفيتامينات المتعددة لمدة دقيقتين مرة واحدة يوميًا لمدة عشرين يومًا. أُخذت قياسات صلابة وخشونة السطح عند بداية الدراسة وبعد 20 يومًا. استُخدم جهاز فيكرز لاختبار الصلابة وجهاز قياس سماكة السطح لقياس صلابة وخشونة السطح. **النتائج:** أظهر الفحص الإحصائي للنتائج باستخدام اختبار تحليل التباين (ANOVA) انخفاض صلابة وخشونة السطح، وزيادة خشونة السطح. هذه النتائج من خط الأساس وحتى ٢٠ يومًا لكل شراب، حيث أظهر أوميغا ٣ أكبر انخفاض في الصلابة الدقيقة، يليه بونفيت. **الاستنتاجات:** الاستخدام المستمر للدواء أو الشراب يعني تعرضه لبيئة حمضية أكثر، مما يزيد من احتمالية تأثير ذلك على الصلابة الدقيقة وخشونة مادة الترميم التجميلية.

الكلمات المفتاحية: الصلابة الدقيقة، الخشونة، المركب، الفيتامينات المتعددة، أوميغا ٣.